The Mathematics Educator
2007, Vol. 17, No. 2, 24–30

Student Attitudes, Conceptions, and Achievement in Introductory Undergraduate College Statistics

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The purpose of this study was to measure student attitudes toward and conceptions about statistics, both before and after an introductory undergraduate college statistics class. Relationships between those attitudes and conceptions, as well as their relationships to achievement in statistics, were also studied. Significant correlations were found between student attitudes and achievement, both at the beginning and end of the course. A low, but significant, correlation was found between positive attitudes toward statistics and accurate conceptions about statistics in the posttest but not in the pretest. Although it was found that there was no change in student attitudes and conceptions over the course of the semester, students did have more positive attitudes and correct conceptions than expected. Additionally, instructor interviews revealed that the most common technique employed to improve student attitudes and conceptions was the use of real-world applications.

Students typically enter college mathematics classes with certain attitudes and preconceptions toward the subject. Upon completion of the course, some students may exit with new or changed attitudes and conceptions due to instructor intervention and exposure to content. This study, originally a doctoral dissertation (Evans, 2005), focuses on student attitudes toward statistics, conceptions about statistics, and achievement in introductory undergraduate college statistics classes. Although student attitudes and achievement in statistics have previously been investigated separately, the correlation between student attitudes and conceptions in this subject has not been as widely documented (Barkley, 1995). Also, no research was found regarding instructors' methods for improving student attitudes and changing student misconceptions in the statistics classroom.

Student attitudes toward statistics incorporates elements from Thurstone's (1970) definition and is a measure of students' positive and negative feelings toward the subject of statistics in terms of relevance and value, difficulty and self-efficacy, and general impression toward the subject. The phrase student conceptions about statistics—combining ideas from Davis and Palladino (2002) and Barkley (1995)—addresses student ideas and beliefs about statistics. This includes assessing the degree of student understanding of what questions can or cannot be answered using probability and statistics, as well as applying probabilistic and statistical concepts in appropriate situations. It is important, however, to differentiate conceptions from achievement. Achievement is defined by student ability in computations and solving problems, which can normally be measured by written tests. Conceptions deal more with deeper understanding. For example, it is one thing to know how to calculate a Pearson correlation coefficient, but it is quite another to know that a Pearson correlation coefficient is a measure of the strength of the linear relationship between two variables.

The connection between attitudes and achievement in mathematics has a rich history. Aiken (1970, 1974, 1976) found significant relationships between attitudes toward mathematics and achievement. Specifically, he showed that attitudes and achievement in mathematics are reciprocal: students who have better attitudes towards mathematics demonstrate higher achievement, and students who have higher achievement exhibit better attitudes. These results confirmed earlier work by Neale (1969), who found a low, but significant, relationship between attitudes toward mathematics and achievement. Ma and Kishor's (1997) meta-analysis on the relationship between attitude toward and achievement in mathematics found a statistically significant positive relationship between the two variables. Although this relationship was found to be reliable, it was not found to be strong.

Similarly in statistics, Schultz and Koshino (1998) showed that there exists a consistent positive relationship between attitudes toward statistics and achievement in statistics, confirming results from Arkaki and Schultz (1995); Elmore and Lewis (1991);

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Elmore, Lewis, and Bay (1993); Roberts and Saxe (1982); Sutarso (1992); and Wise (1985). Furthermore, Feinberg and Halperin (1978) reported that measures of anxiety and attitudes, among other variables, were significantly related to course outcome. Additionally, Gal and Ginsburg (1994) found that negative attitudes and beliefs about statistics can impede the learning of statistics. Sutarso (1992) said that it would be useful for instructors to know student attitudes toward the subject so that instructors could use better teaching strategies to overcome such problems. Finally, Rogness (1993) agreed that understanding student attitudes toward statistics can assist in creating an individualized intervention strategy to help remove some of the anxiety for a specific student.

According to Gredler (2001), Bandura's Social Cognitive Learning Theory says, "Self-efficacy is the learner's belief in his or her capabilities to successfully manage situations that may include novel or unpredictable elements" (p. 330). Gredler, summarizing Bandura's conclusion, says, "Self-efficacy beliefs affect human functioning indirectly by influencing individuals' cognitive, motivational, affective, and selection processes. Individuals with high self-efficacy construct success scenarios, set challenging goals, persist in the face of difficulties, and control disturbing thoughts" (p. 330). This gives educational research on student attitudes a theoretical perspective while also providing a clear justification for improvement of attitudes regarding student self-efficacy.

Shaughnessy (1992) claimed, "We need to develop some standard, reliable tools to assess our students' conceptions of probability and statistics" (p. 489). These instruments should build on previous research and investigate students' conceptions of probability and statistics for many different grade levels. Responding to this need, Hirsch and O'Donnell (2001) developed and used an instrument to measure student misconceptions. They determined that, despite a formal course in statistics, students continued to demonstrate misconceptions. Other researchers (delMas & Bart, 1987; Garfield, 1981; Garfield & Ahlgren, 1988; Huck, 2007; Kahneman & Tversky, 1972, 1973; Konold, 1991; Landwehr, 1989) have also identified student misconceptions. The National Council of Teachers of Mathematics (NCTM), in the Data Analysis and Probability section of *Principles and Standards for School Mathematics* (2000), states, "Misconceptions that arise because of students' representations of data offer situations for new learning and instructions" (p. 113). If instructors were aware of the common misconceptions students have before, and retain after, participation in an introductory statistics course, their practices could be adapted to assist students in improving their understanding of statistics (Barkley, 1995; Landwehr, 1989; Shaughnessy, 1977, 1992).

Research Questions

The following research questions guided this study.

1. To what extent do student attitudes toward statistics and conceptions about statistics change after taking an undergraduate introductory statistics course?
2. What differences exist with regard to student prior, as well as post, attitudes and conceptions toward statistics among the different departments offering an introductory undergraduate college statistics class (mathematics, psychology, and sociology)?
3. Is there a correlation between positive attitudes toward statistics and accurate conceptions about statistics prior to and after completing an undergraduate introductory statistics course?
4. Do student attitudes and conceptions significantly predict achievement in an undergraduate introductory statistics course?
5. What types of interventions have instructors utilized to improve student attitudes toward statistics and improve student conceptions about statistics throughout the course of the semester?

Methodology

The methodology of this study involves a non-experimental student survey and instructor interview. The sample in this study consisted of students in six randomly selected statistics classes from the mathematics (n = 30 from two classes), psychology (n = 43 from three classes), and sociology (n = 42 from one double-sized class[1]) departments and their instructors (n = 5) at a large urban university in the northeastern United States. There were 80 female and 35 male students. All three departments offered introductory statistics courses addressing the same topics. Students completed a survey instrument entitled "Student Attitudes and Conceptions in Statistics" (STACS) (Evans, 2005) that focused on both attitudes (30 items) and statistical concepts (14 items). Both the attitudinal and conceptual sections used a 5-point Likert-type scale coded with a range of 0 to 4, with a score of 4 indicating strong agreement, a score of 2 indicating neutral agreement/disagreement, and a score of 0 indicating strong disagreement. For negative attitudes and incorrect conceptions the scoring was reversed. This survey instrument was based upon preexisting survey instruments (Barkley, 1995; Gilovich, Vallone, & Tversky, 1985; Huff, 1954; Rogness, 1993; Shaughnessy, 1992; Sutarso, 1992; Wise, 1985). Items for attitudes on STACS consisted of statements such as "I enjoy statistics" and "I would rather not be taking statistics." Items for conceptions on STACS consisted of statements such as "If a commercial claim is that a study found 9 out of 10 dentists prefer All Clean Brand toothpaste, then the claim is very questionable" and "If I flip a coin nine times and get nine tails, the next flip will more likely be heads" (Evans, 2005). Students completed the questionnaire twice, once at the beginning and once at the end of the semester. The results of the STACS were used to answer research questions 1 through 4. To answer research question 5, the instructors were interviewed by the researcher at the end of the semester using a list of direct open-ended questions pertaining to what instructors did to improve attitudes and eliminate misconceptions for their students. Student achievement was measured by final course grade, which used a standard 100-point grading scale. Final course grades in all departments were primarily determined by standard written tests involving statistical computations.

Results

To determine internal consistency, Cronbach's alpha for the STACS questionnaire was .92 for the attitudes section and .59 for the conceptions section. These values indicate that the attitudes section of the instrument has high internal consistency, whereas the conceptions section has questionable internal consistency. Therefore, the results found using the conceptions section should be interpreted more cautiously than those found using the attitudes section of the instrument.

Research questions 1 and 2, regarding changes in attitudes and conceptions and differences between the academic departments, were answered using a 3 x 2 repeated measures MANOVA. One independent variable is academic department offering a statistics course; this variable has three levels (mathematics, psychology, and sociology). Another independent variable is score on the attitudes and conceptions survey, with two levels (pretest and posttest). The MANOVA determines whether or not significant differences exist among the students' mean scores for attitudes and conceptions, by department, as well as if significant differences exist between the mean scores on the pretest and posttest for attitudes and conceptions.

There were no overall statistically significant differences between the students' pretests and posttests for attitudes and conceptions, $F(1, 228) = 0.166$, $p = .684$. Therefore, these students exhibited no significant change in attitudes and conceptions toward statistics over the course of the semester.

However, statistically significant differences were found for attitudinal and conceptual scores among the different departments (mathematics, psychology, and sociology) with $F(2, 227) = 9.193$, $p = .000$. Separate ANOVAs were used to find differences for attitudes and conceptions with $F(2, 227) = 30.412$, $p = .000$, and $F(2, 227) = 6.119$, $p = .003$, respectively. A post hoc test (Tukey HSD) determined exactly where the means differed among departments for both attitudes and conceptions. Overall, students in the sociology department demonstrated more positive attitudes toward statistics than did students in the mathematics and psychology departments with $p = .000$. Students in the sociology department also demonstrated more correct conceptions than did students in the mathematics department with $p = .002$. There were no other statistically significant differences found. The descriptive statistics are summarized in Table 1.

Because there were no significant changes in attitudes and conceptions, an additional analysis determined if the participants had significantly more positive than neutral attitudes towards statistics and more correct conceptions about statistics, as measured by their responses on STACS[2]. For both the pretest and posttest, an independent samples two-tailed t test revealed that students did, in fact, have statistically significant positive attitudes and correct conceptions. The results are summarized in Tables 2 and 3. Despite having positive attitudes towards statistics, student responses indicated that they would rather not be taking statistics and would not enjoy taking other statistics courses in the future. Furthermore, students claimed they would not have taken statistics if it were not required; they did not find statistics very valuable in their programs of study. Although students held more correct conceptions than expected by the researcher, many students held the misconception that results can be extrapolated into the distant future. Students also failed to realize that the size of a population does not influence the sample size needed

Table 1

Means and Standard Deviations for Pretests and Posttests for Attitude and Conceptions Scores

Test and Department	Mean	Standard Deviation
Attitudes Pretest		
Mathematics	2.06	0.439
Psychology	2.23	0.423
Sociology	2.52	0.369
Total	2.29	0.446
Attitudes Posttest		
Mathematics	2.02	0.522
Psychology	2.14	0.476
Sociology	2.61	0.355
Total	2.28	0.514
Conceptions Pretest		
Mathematics	2.26	0.259
Psychology	2.37	0.408
Sociology	2.46	0.278
Total	2.37	0.335
Conceptions Posttest		
Mathematics	2.22	0.263
Psychology	2.32	0.425
Sociology	2.42	0.300
Total	2.33	0.350

Table 2

Overall Results for the Pretest

	Mean	Standard Deviation	*t* value	Significance
Attitudes	2.292	0.446	7.019	.000*
Conceptions	2.373	0.335	11.926	.000*

Note. Student attitudes and conceptions scores were compared to a neutral value coded as 2 on the instrument (from a range of 0 to 4).
* $p < .05$, two tails

Table 3

Overall Results for the Posttest

	Mean	Standard Deviation	*t* value	Significance
Attitudes	2.280	0.514	5.852	.000*
Conceptions	2.330	0.350	10.110	.000*

Note. Student attitudes and conceptions scores were compared to a neutral value coded as 2 on the instrument (from a range of 0 to 4).
* $p < .05$, two tails

to use inference techniques as long as the population is much larger than the sample size.

A Pearson correlation addressed research question 3, regarding the relationship between attitudes and conceptions. No significant correlation existed between positive attitudes toward statistics and accurate conceptions about statistics for the pretest, $r = .143$, $n = 115$, $p = .127$. However, the posttest revealed a low, but significant, correlation between positive attitudes toward statistics and accurate conceptions about statistics, $r = .197$, $n = 115$, $p = .035$. Because this correlation is low, it is questionable if attitudes toward statistics can be used to predict conceptions in statistics after an introductory statistics class.

Additional analyses determined if significant correlations existed between positive attitudes toward statistics and accurate conceptions about statistics for the pretests and posttests for the individual departments. The mathematics department exhibited the only significant correlations for the pretests and posttests, with $r = .451$, $n = 30$, $p = .012$, and $r = .431$, $n = 30$, $p = .018$, respectively.

The predictability of achievement using the measures of attitudes and conceptions, the focus of the fourth research question, was addressed using a Pearson correlation and linear regression. Neither initial student conceptions and course grades nor final student conceptions and course grades revealed significant correlations. However, significant correlations were found between initial and final student attitudes and course grades, $r = .203$, $R^2 = .04$, $n = 115$, $p = .030$, and $r = .247$, $R^2 = .06$, $n = 115$, $p = .008$, respectively. A simple regression equation was calculated for initial student attitude level and final course grades: $y = 76.045 + 4.324x$, where x represents initial attitudinal level and y represents final course grade. A simple regression equation was also calculated for final student attitude level and final course grades: $y = 75.526 + 4.574x$, where x represents final attitudinal level and y represents final course grade. However, because the R-squared values were fairly low in both cases, caution should be taken when interpreting the regression equations. Although a significant linear relationship was found, practicality and utility are of questionable consequence; course grades cannot necessarily be predicted from the initial or final student attitudes towards statistics.

Instructor interviews informed research question 5, regarding instructor interventions to improve attitudes and eliminate misconceptions. Instructors generally said that they try to link the material from the statistics courses to real-world problems. This was the most commonly used technique for generating interest, improving student attitudes, and eliminating misconceptions in statistics. One instructor demonstrated the link between statistics and future courses the students would study. Another instructor used humor, optimism, and enthusiasm for statistics to generate more interest. To improve attitudes and eliminate misconceptions, one instructor had students gather survey data regarding opinions on an upcoming political election. This served as a real-world example to help students better understand statistical conceptions and their real-life applications. The added dimension of data collection allowed students to use their own data for statistical analysis.

Discussion

Based on research and prior experience, it was expected that there would be a change in student attitudes and conceptions towards statistics over the course of the semester. It was also expected that students would not have positive attitudes toward statistics and that students would have a number of misconceptions in statistics. The results of the study presented evidence refuting these expectations. With these findings taken into consideration, the fact that no significant change occurred in attitudes and conceptions is not as disappointing. Students already held generally positive attitudes and generally correct conceptions in statistics and thus it would be quite difficult to improve already positive attitudes and correct conceptions. This indicates that the commonly held belief in education that students have negative attitudes toward statistics and many misconceptions about the nature of statistics (Paulos, 1988) may in fact no longer be true. It may be that since the mean age of the subjects surveyed in this study was 21 years old, many of these students learned mathematics from teachers who may have followed recommendations from the NCTM (1989, 2000) *Curriculum and Evaluation Standards for School Mathematics* and *Principles and Standards for School Mathematics*. Since the *Standards* emphasize statistics and probability, today's students may have a better appreciation for and understanding of statistics than students in the past. Much of the prior research studied students who were in school before the *Curriculum and Evaluation Standards for School Mathematics* was published and implemented (Heaton & Mickelson, 2002). This could explain why student attitudes and conceptions in the present study were generally better than previously believed. The attitudes and conceptions of students who experienced data analysis and probability in their earlier schooling, compared with those who lacked those experiences, provides another area for future research.

Another unexpected result was that students taking statistics in the sociology department had more positive attitudes toward statistics than did students taking statistics in the mathematics and psychology departments. Also, students taking statistics in the sociology department had more correct conceptions about the nature of statistics than did students taking statistics in the mathematics department. This difference may be attributed to the fact that statistics classes in the mathematics department include students from a variety of majors, whereas the sociology statistics classes are designed for sociology majors. Students taking statistics in the mathematics department are fulfilling a required university course as part of a core curriculum. Classes offered in the sociology department are geared toward the work of sociologists. Since sociologists make extensive use of statistics in their literature and research, students may have had more interest in and exposure to statistics. However, there are two possible problems with this explanation. First, this does not explain why sociology students held more positive attitudes than psychology students since psychologists also make extensive use of statistics in their literature and research. However, this researcher believes that many students, when unsure of what major to choose, major in psychology. This may not be the case in sociology. Second, because over half of the students in this study were college sophomores, they had only begun to gain exposure to literature in their fields. Differences in attitudes and conceptions in statistics among students from different departments should be further studied.

Despite having overall positive attitudes, students still reported some negative attitudes toward statistics. Some students might generally find statistics to be a worthy area of study and to be a subject in which they believe they can perform well. However, other students might feel statistics is something they would rather not be taking at the present time and not need in their own careers. The students in the latter group might feel that statistics is a useful subject for others but not for them specifically. Future research could investigate why students hold these beliefs.

The NCTM (2000) recommended that K-12 students be encouraged to make statistical and probability-based predictions and to compare those predictions with actual outcomes. Students will be challenged to confront misconceptions through discrepancies in their predictions. Similarly, a more "hands-on" approach to statistics such as that recommended for K-12 students might be beneficial for college students, more so than just using real-world problems from the textbook. One instructor in this study used a survey approach to statistics in which the students surveyed other students on voting and political issues for an upcoming election. After collecting data, the students analyzed the data and developed conclusions. Perhaps this type of investigative approach to statistics could further improve attitudes and eliminate misconceptions.

Students, both at the beginning and end of the course, reported relatively positive attitudes about their own self-efficacy in statistics, but ways of improving the view of the utility of statistics are needed. Student views could be further improved by making connections to various careers that use statistics, providing students with opportunities to see the versatility of statistics. This appeared to be the area where students had the poorest attitudes.

The type, quality, and quantity of real-world applications that instructors use to generate interest, improve attitudes, and eliminate misconceptions should be further studied. Questions on the nature of these real-world problems should be investigated. How "real-world" are these problems? Do they come straight from the textbook or are they constructed by the instructors? How many of the real-world applications use actual data collection and analysis? Are the real-world problems authentic or developed specifically for the course? How much class time is dedicated to real-world applications? Answering these questions could contribute to improving college students' statistical education.

References

Aiken, L. R. (1970). Attitudes toward mathematics. *Review of Educational Research, 40*, 551–596.

Aiken, L. R. (1974). Two scales of attitude toward mathematics. *Journal for Research in Mathematics Education, 5*, 67–71.

Aiken, L. R. (1976). Update on attitudes and other affective variables in learning mathematics. *Review of Educational Research, 46*, 293–311.

Araki, L. R., & Schultz, K. S. (1995, April). *Students' attitudes towards statistics and their retention of statistical concepts*. Paper presented at the annual meeting of the Western Psychological Association, Los Angeles, CA.

Barkley, C. A. (1995). A study of misconceptions in statistics and statistics anxiety: Affect and performance in an undergraduate math course (Doctoral dissertation, University of Denver, 1995). *Dissertation Abstracts International,* AAI9543983.

Davis, S. F., & Palladino, J. J. (2002). *Psychology* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

delMas, R. C., & Bart, W. M. (1987, April). *The role of an evaluation exercise in the resolution of misconceptions in probability*. Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Elmore, P. B., & Lewis, E. L. (1991, April). *Statistics and computer attitudes and achievement of students enrolled in applied statistics: Effects of a computer laboratory*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Elmore, P. B., Lewis, E. L., & Bay, M. L. (1993, April). *Statistics achievement: A function of attitudes and related experience*. Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Evans, B. R. (2005). Student attitudes, conceptions, and achievement in introductory undergraduate college statistics (Doctoral Dissertation, Temple University, 2005). *Dissertation Abstracts International,* AAI3178774.

Feinberg, L. B., & Halperin, S. (1978). Affective and cognitive correlates of course performance in introductory statistics. *Journal of Experimental Education, 46*(4), 11–18.

Garfield, J. (1981). An investigation of factors influencing student attainment of statistical competence (Doctoral Dissertation, University of Minnesota, 1981). *Dissertation Abstracts International, 42,* AA18211476.

Garfield, J., & Ahlgren, A. (1988). Difficulties in learning basic concepts in probability and statistics: Implications for research. *Journal for Research in Mathematics Education, 19*, 44–63.

Gal, I., & Ginsburg, L. (1994). The role of beliefs and attitudes in learning statistics: Towards an assessment framework. *Journal of Statistics Education, 2*(2), 1–16.

Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology, 17*, 295–314.

Gredler, M. E. (2001). *Learning and instruction: Theory into practice* (4th ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Heaton, R. M., & Mickelson, W. T. (2002). The learning and teaching of statistical investigation in teaching and teacher education. *Journal of Mathematics Teacher Education, 5*, 35–59.

Hirsch, L. S., & O'Donnell, A. M. (2001). Representativeness in statistical reasoning: Identifying and assessing misconceptions [Electronic version]. *Journal of Statistics Education, 9*(2).

Huck, S. W. (2007) *Reading statistics and research* (5th ed.). Boston: Allyn & Bacon.

Huff, D. (1954). *How to lie with statistics*. New York: Norton.

Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology, 3,* 430–454.

Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80,* 237–251.

Konold, C. E. (1991). Understanding students' beliefs about probability. In E. von Glasersfeld (Ed.), *Radical constructivism in mathematics education* (pp. 139–156). The Netherlands: Kluwer.

Landwehr, J. (1989, September). A reaction to alternative conceptions of probability. In J. Garfield (Chair), *Alternative conceptions of probability: Implications for research, teaching, and curriculum*. Symposium conducted at the annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, New Brunswick, NJ.

Ma, X., & Kishor, N. (1997). Assessing the relationship between attitude toward mathematics and achievement in mathematics: A meta-analysis. *Journal for Research in Mathematics Education, 28*, 26–47.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Neale, D. C. (1969). The role of attitudes in learning mathematics. *Arithmetic Teacher, 16,* 631–640.

Paulos, J. A. (1988). *Innumeracy: Mathematical illiteracy and its consequences.* New York: Vintage Books.

Roberts, D. M., & Saxe J. E. (1982). Validity of a statistics attitude survey: A follow-up study. *Educational and Psychological Measurement, 42*, 907–912.

Rogness, N. T. (1993). The development and validation of a multi-factorial instrument designed to measure student attitudes toward a course in statistics (Doctoral Dissertation, University of Northern Colorado, 1993). *Dissertation Abstracts International,* AAI9413644.

Shaughnessy, J. M. (1977). Misconceptions of probability: An experiment with a small-group, activity-based, model building approach to introductory probability at the college level. *Educational Studies in Mathematics, 8,* 295–316.

Shaughnessy, J. M. (1992). Research in probability and statistics: Reflections and directions. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 465–494). New York: Macmillan.

Schultz, K. S., & Koshino, H. (1998). Evidence of reliability and validity for Wise's attitude toward statistics scale. *Educational and Psychological Measurement, 82*, 27–31.

Sutarso, T. (1992, November). *Students' attitudes toward statistics (STATS).* Paper presented at the annual meeting of the Mid-South Educational Research Association, Knoxville, TN.

Thurstone, L. L. (1970). Attitudes can be measured. In G. F. Summers (Ed.), *Attitude measurement* (pp. 127–141). Chicago: Rand McNally.

Wise, S. L. (1985). The development and validity of a scale measuring attitudes toward statistics. *Educational and Psychological Measurement, 45*, 401–405.

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[1]The double-sized sociology class was one class consisting of two sections intended to be twice the size of a regular one-class section.

[2]On STACS, a 2 indicates a neutral response, with higher numbers representing positive attitudes or correct conceptions.